July 3, 1951 H. W. BROWN, JR 2,559,494

PIEZOELECTRIC CRYSTAL HOLDER

Filed April 29, 1949

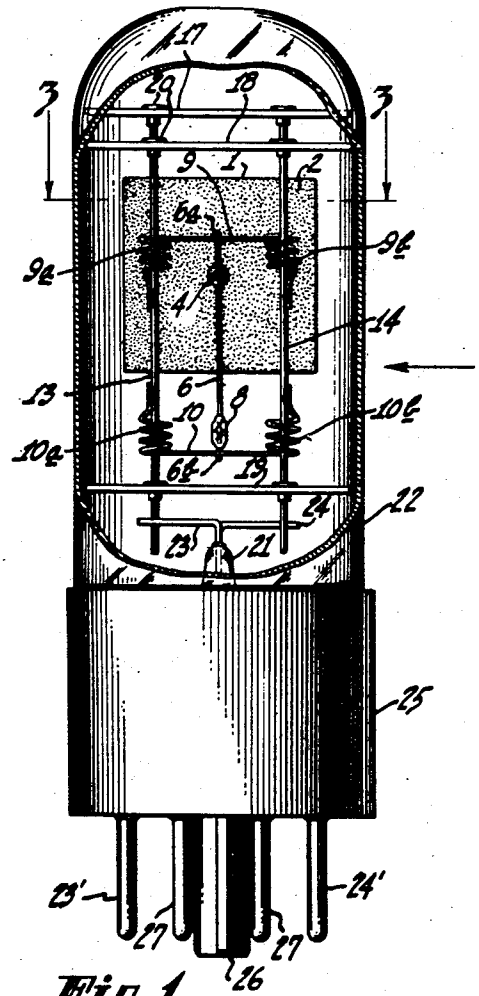


Fig. 1.

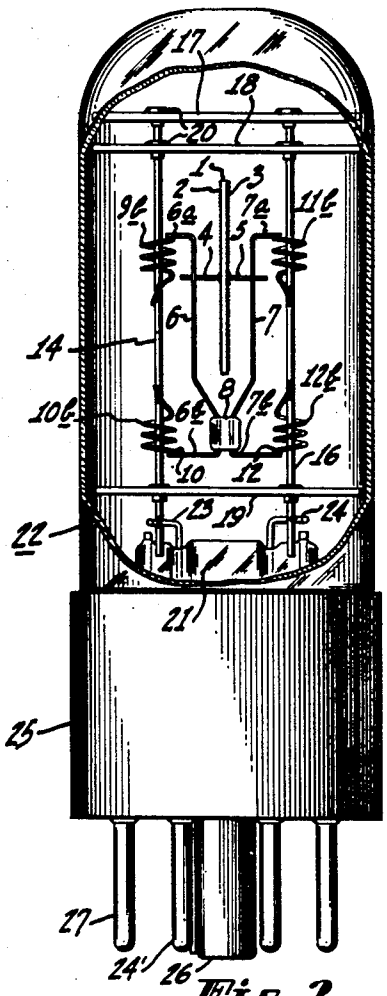


Fig. 2.

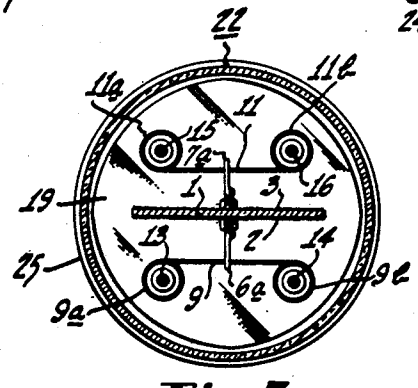


Fig. 3.

INVENTOR
HERBERT W. BROWN, JR.
BY Morris P. Kirschstein
ATTORNEY

Patented July 3, 1951

2,559,494

UNITED STATES PATENT OFFICE

2,559,494

PIEZOELECTRIC CRYSTAL HOLDER

Herbert W. Brown, Jr., Haddonfield, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application April 29, 1949, Serial No. 90,323

5 Claims. (Cl. 171—327)

1

This invention relates to improvements in shock-proof mountings for piezoelectric crystals and analogous vibratile elements.

It has previously been proposed (see Robb et al., 2,416,067) to mount a piezoelectric crystal on its electrode leads between the arms of a U-shaped yoke and to support the yoke adjacent to the terminals of said leads on a pair of compression springs wrapped about an axis which forms an extension of the leads. In submitting such holders to shocks and tremors of a frequency of from 1 to, say, 100 cycles per second, instances have arisen wherein the crystal failed to oscillate in its normal or intended mode. These departures from normal operation appear to have been due, in some instances, to mechanical resonance in the axially disposed springs; in other instances to torsion or twisting of the springs about their common axis, and in other instances to inequalities in the force of the springs.

Accordingly, the principal object of the present invention is to provide an improved spring-type support for piezoelectric crystals and one which obviates the foregoing and other less apparent operating disadvantages of present-day crystal holders.

Another and important object of the invention is to provide an improved yoke-type, spring-supported, crystal holder and one wherein the crystal and its leads may be attached within the yoke subsequent to the assembly of the supporting structure or frame upon which the springs are mounted.

Stated generally, the foregoing and other objects are achieved in accordance with the invention, by mounting the yoke for the crystal in an open-sided frame or arbor containing a number of suspension springs whose axes extend in directions normal to the direction of extension of the electrode leads of the crystal, and by connecting the yoke to the springs at a number (say, four) of symmetrically disposed points remote from said axis.

Certain preferred details of construction together with other objects and advantages will be apparent, and the invention itself will be best understood upon reference to the accompanying drawing, wherein:

Fig. 1 is a front elevation,

Fig. 2 is a side elevation of a shockproof crystal holder constructed in accordance with the principle of the invention and supported in an evacuated envelope, a portion of the envelope being cut away to reveal details of construction of the holder, and

2

Fig. 3 is a sectional view of the holder taken on the line 3—3 of Fig. 1.

In the drawing, 1 designates a quartz or other piezoelectric crystal of a conventional form, and of dimensions dictated by the frequency-response characteristic desired. As is also conventional, this vibratile element 1 is provided on each of its two major faces with one of a pair of adherent metal electrodes 2 and 3 and with a pair of rigid electrode leads 4 and 5 which extend outwardly in opposite directions normal to the electrode faces 2 and 3 from a central nodal point or region on or within the crystal. These oppositely extending crystal-supporting leads 4 and 5 are in turn affixed, as by welds, or solder, adjacent to their outer ends, within a yoke-like structure comprising a pair of vertically extending, rigid, wire-like conductors 6 and 7. These oppositely located rigid conductors are bent inwardly toward each other well beneath the lower edge of the crystal 1 and extend through a glass or other insulating bead 8, without touching each other. As shown more clearly in Fig. 2, the rigid wires 6 and 7 of which the yoke 6, 7, 8 is comprised have their end portions 6*a*, 6*b*, 7*a*, 7*b* bent outwardly each in the same direction as the electrode lead (4 or 5) which is attached to that wire and, as shown in Figs. 1 and 3, the outwardly bent parts 6*a*, 6*b* of one wire are attached to the midpoints of a pair of horizontally extending cross-pieces 9 and 10 on one side of the crystal, and the corresponding parts 7*a*, 7*b* of the other wire 7 are attached to the midpoints of a duplicate pair of cross-pieces 11 and 12, respectively, on the other side of the crystal.

The cross-pieces 9—10, 11—12, to which the opposite ends of the yoke pieces 6 and 7 are respectively connected, each form a connecting link between a pair of oppositely located suspension springs 9*a*—9*b*, 10*a*—10*b*, etc. whose axes extend in parallel directions normal to the axis of the electrode leads 2 and 3 to which the crystal 1 is affixed.

Two vertically extending pairs of conductive posts 13—14, 15—16 are disposed in spaced-apart parallel relation on opposite sides of the crystal. Each post serves as a support for one of the "upper" and one of the "lower" springs. Each spring is wrapped loosely about its post and is secured at one end thereto as by a soldering or welding operation. All of the springs on one side of the crystal are preferably wound in a common direction and the ones of the other side are preferably wound in the opposite direction in order to minimize the possibility of mechanical reso-

nance in the assembly. The rods are shown maintained in rigid, spaced alignment by two insulating "top" plates 17 and 18 and a similar "bottom" plate 19 through which said posts extend and to which the posts are affixed as by grommets 20. The posts 13—16 and end-plates 17—19, when thus joined, form an open-sided frame, arbor or sub-assembly within which the yoke, without the crystal, may be secured prior to mounting the assembly upon the press 21 of a vacuum tube 22. Thereafter, before placing the bulb in position about the press, the crystal and its electrode leads may be entered into the yoke through the open sides of the frame and soldered or welded to the oppositely located upstanding arms 6 and 7 of the yoke. Obviously, if the necessity arises, the crystal 1 and its electrode leads 4 and 5 may be removed from the yoke, for purposes of inspection or adjustment without damage either to the crystal or to its supports.

In order to lend added rigidity to the frame or arbor, its upper end-plates 18 and 19 may be made of a diameter corresponding substantially to the inside diameter of the envelope of the vacuum tube within which the frame is mounted, so that the frame cannot tilt about its vertical axis. This added precaution need not ordinarily be taken with the lower disc 19 in view of the proximity of that end of the assembly to the (four) right-angle metal rods 23, 24 which serve to support the frame on the press 21.

As indicated in Figures 1 and 2, two of these metal supporting rods 23 and 24 extend through the press where they terminate in socket prongs 23' and 24' through which electrical connections may be made to the electrodes 2 and 3 on the crystal. As in standard practice, the socket 25 of the tube 22 may be provided with a centering prong 26 and with any desired number and distribution of dummy prongs 27.

From the foregoing it will be apparent that the present invention provides an improved yoke-type, spring-supported, crystal holder and one wherein the number, orientation and disposition of the springs effectively prevent the transfer, to the crystal, of shocks and tremors of external origin.

What is claimed is:

1. A piezoelectric crystal unit comprising a piezoelectric crystal having oppositely located electrode faces and a pair of electrode leads extending outwardly from said faces in opposite directions substantially normal to said faces, a relatively rigid yoke-like structure within which said

electrode leads are secured, and a plurality of coil springs upon which said yoke-like structure is suspended, said springs having substantially parallel axes extending in a direction substantially normal to said electrode leads and substantially parallel to said electrode faces.

2. A piezoelectric crystal unit comprising a piezoelectric crystal having oppositely located electrode faces and a pair of electrode leads extending outwardly from said faces in opposite directions substantially normal to said faces, a yoke-like structure within which said electrode leads are secured, and a plurality of pairs of coil springs upon which said yoke-like structure is suspended, said pairs of springs being disposed on opposite sides of said crystal, and said springs having substantially parallel axes extending in a direction substantially normal to said electrode leads and substantially parallel to said electrode faces.

3. A crystal holder comprising a plurality of oppositely located pairs of posts mounted in spaced-apart parallel array, a pair of axially extending coil springs disposed about each of said posts, the coil springs of each pair being connected each at one end to the post about which it is disposed, a connection between the free end of each spring and the corresponding spring of an adjacent pair, and a crystal-supporting structure mounted upon said spring connections.

4. The invention as set forth in claim 3 and wherein said crystal-supporting structure comprises a pair of mutually insulated conductors having terminal portions secured respectively to the midpoint of said spring connections.

5. The invention as set forth in claim 3 and wherein said coil springs are disposed on opposite sides of said crystal supporting structure, the springs on one side of said structure being coiled in one direction and the coils on the other side of said structure being coiled in the opposite direction.

HERBERT W. BROWN, JR.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,275,122	Ziegler	Mar. 3, 1942
2,371,613	Fair	Mar. 20, 1945
2,441,139	Fair	May 11, 1948